OVERHEAT PREVENTION APPARATUS AND GAS RANGE HAVING THE OVERHEAT PREVENTION APPARATUS

Technical Field

The present invention relates to an overheat prevention apparatus and a gas range including the same, and more particularly, to an overheat prevention apparatus, in which a timer switch is combined with a magnetic opening/closing unit using a thermocouple so as to ignite a burner only after a time is set using the timer switch; a gas range including the overheat prevention apparatus; an electronic overheat prevention apparatus, which opens a magnetic opening/closing unit when a burner fire is sensed and closes the magnetic opening/closing unit when elapse of a predetermined time or extinction of the burner fire is detected; and a gas range including electronic overheat prevention apparatus.

It can be said that human civilization has been developed with use of fire. With the development of human civilization, fuel used by human beings has been developed. Recently, apparatuses directly using gas (for example, liquefied natural gas (LNG), liquefied petroleum gas (LPG), and butane gas) as fuel for cooking or heating have been continuously developed.

Such gas fuel has superior thermal efficiency to oil or coal fuel, is easy to treat, and has environmental affinity since it does not cause air pollution. However, gas fuel involves the danger of exploding or causing a fire due to even a small spark. Accordingly, gas ranges are legally obligated to be provided with various safety apparatuses, and products, which are safe against even a user's carelessness, have been developed. Hereinafter, a gas range is defined as including apparatuses, such as a gas range for cooking, a gas stove, and a portable gas range, which are used for cooking or heating using gas as fuel.

In conventional gas ranges, when fire of a burner is extinguished because of overflow of food, strong wind, or user's erroneous use, unburned gas flows out and may cause an accident such as a fire. Conventional gas ranges are designed such that a gas supply passage is maintained open during operation. As a result, gas continuously flows out even if fire of a burner is extinguished during operation. Accordingly, if a user does not turn off gas with a gas control knob, unburned gas continuously flows out through the burner. In this situation, when the user reignites the burner using the gas control knob, it is highly possible that an accident such as an explosion or a fire breaks out due to the gas that has flowed out.

Background Art

In order to prevent an accident from occurring, a gas range including a magnetic opening/closing unit using a thermocouple has been developed In such a gas range, a thermocouple is installed near a burner. When the burner is ignited, a thermoelectromotive force is generated in the thermocouple. The magnetic opening/closing unit is supplied with the thermoelectromotive force and generates a magnetic force so as to maintain a gas supply passage open. Accordingly, when a user opens the gas supply passage by pressing a gas control knob, gas is supplied to the burner so as to ignite the burner. Thereafter, the magnetic force of the magnetic opening/closing unit, which is generated due to the thermoelectromotive force generated by the thermocouple, replaces the user's pressure so as to maintain the gas passage open. Consequently, when there is fire in the burner, the gas supply passage is maintained open by the magnetic force of the magnetic opening/closing unit even after the user stops pressing the gas control knob. However, when the fire of the burner is extinguished, the thermoelectromotive force of the thermocouple is gone, and thus the magnetic force of the magnetic

opening/closing unit is also gone. As a result, the gas supply passage is blocked, and an outflow of gas is prevented.

However, when a user carelessly leaves a gas range, which includes a gas opening/closing unit using a thermocouple, turned on for a long period of time, overheating may cause a fire. For example, when a user forgets to turn off the gas range after turning it on because he/she is absorbed in doing other affairs, food is overheated or burned, which may cause a fire. In order to overcome this problem, conventional technology provides a method using a timer. In the method, a user can selectively set the timer, and a gas supply passage is blocked after time set in the timer lapses.

However, even the method using a timer selectively cannot be completely safe from a user's carelessness. For example, it frequently happens that a user goes out or takes a nap without setting the timer after turning on a gas heater, which causes a fire.

In addition, in a gas opening/closing unit using a thermocouple, even when a burner is ignited, it takes some amount of heating time for the thermocouple to generate a sufficient thermoelectromotive force to allow a magnetic opening/closing unit to maintain a gas supply passage open. When a user stops pressing a gas control knob before this heating time lapses, the gas supply passage is blocked, and fire of a burner is extinguished. This happens frequently.

Moreover, a user needs to visually check fire of a burner in a gas range employing a magnetic opening/closing unit using a thermocouple. However, this checking is very troublesome when the gas range is installed at a much lower place than the normal height of the user's eyes.

Disclosure of the Invention

The present invention provides an overheat prevention apparatus, through which a timer switch is installed in a gas range including a magnetic opening/closing unit using a thermocouple so as to allow the

gas range to operate only after time is set using the timer switch, and a gas supply passage is blocked after the time lapses, thereby preventing accidents such as explosion and fire from occurring due to user's carelessness, and a gas range including the overheat prevention apparatus.

The present invention provides an electronic overheat prevention apparatus, which intercepts the supply of gas after predetermined time has lapsed since burner fire was sensed regardless of user's operation, thereby preventing accidents, and which provides a sufficient electromotive force to allow a magnetic opening/closing unit to maintain a gas supply passage open immediately after burner fire is sensed and allows the burner fire to be easily checked outside, and a gas range including the electronic overheat prevention apparatus.

According to an aspect of the present invention, there is provided an overheat prevention apparatus including a thermocouple, which is installed at a burner of a gas range and generates a thermoelectromotive force due to burner fire; a magnetic opening/closing unit, which generates a magnetic force due to the thermoelectromotive force of the thermocouple so as to selectively open or close a gas supply passage; and a timer switch, which is installed between one output terminal of the thermocouple and one input terminal of the magnetic opening/closing unit, electrically disconnects circuits the two terminals in an "OFF" status and an end-of-set status, and electrically connects the two terminals while a time setup is maintained.

According to another aspect of the present invention, there is provided a gas range including a burner, which generates fire by burning gas; and an overheat prevention apparatus. The overheat prevention apparatus includes a thermocouple, which is installed at the burner and generates a thermoelectromotive force due to burner fire; a magnetic opening/closing unit, which generates a magnetic force due to the thermoelectromotive force of the thermocouple so as to selectively open

or close a gas supply passage through which the gas is supplied to the burner; and a timer switch, which is installed between one of two output terminals of the thermocouple and one of two input terminals of the magnetic opening/closing unit, electrically disconnects circuits the two terminals in an "OFF" status and an end-of-set status, and electrically connects the two terminals while a time setup is maintained.

The gas range may be a gas range for cooking, which uses liquefied petroleum gas (LPG) or liquefied natural gas (LNG) as fuel. The gas range for cooking may include a plurality of burners; a plurality of thermocouples for the respective burners; and a plurality of magnetic opening/closing units corresponding to the plurality of thermocouples, respectively. The timer switch may includes a plurality of switches, each of which electrically connects or disconnects one of two output terminals of each thermocouple and one of two input terminals of a magnetic opening/closing unit corresponding to the thermocouple, the timer switch turning off all of the switches in the "OFF" status and the end-of-set status and turning on all of the switches while the time setup is maintained.

The gas range may be a gas stove using LPG or LNG as fuel.

The gas range may be a portable gas range using portable butane gas as fuel.

According to still another aspect of the present invention, there is provided an electronic overheat prevention apparatus for safely opening or closing a gas supply passage of a gas range including at least one burner. The electronic overheat prevention apparatus includes a power supply unit, which supplies direct current (DC) power having a predetermined electromotive force; at least one thermal sensor, which senses heat of a corresponding burner and generates a thermoelectromotive force; an input button unit, which receives an operating time control signal for each burner from a user; at least one magnetic opening/closing unit, which maintains a gas supply passage to

a corresponding burner when a electromagnetic force is maintained and closes the gas supply passage when the electromagnetic force is lost; a digit display unit, which displays an operating time for each burner in digits; and a control circuit unit, which controls a electromagnetic force to be supplied to each magnetic opening/closing unit when a thermoelectromotive force of a thermal sensor corresponding to the magnetic opening/closing unit exceeds a predetermined threshold value, controls the electromagnetic force supplied to the magnetic opening/closing unit to be intercepted when an operating time lapses or when the thermoelectromotive force of the thermal sensor does not exceed a predetermined threshold value, and controls and manages an operating time of each burner, which is generated by adjusting a predetermined reference operating time according to the operating time control signal, as time flows. When the operating time control signal for a burner is not received from the input button unit, the control circuit unit controls a electromagnetic force, which is supplied to a magnetic opening/closing unit corresponding to the burner, to be intercepted after the predetermined reference operating time lapses.

According to still another aspect of the present invention, there is provided a gas range including a gas supply unit, which supplied gas; at least one burner, which generates fire by burning the supplied gas; and an electronic overheat prevention apparatus. The electronic overheat prevention apparatus includes a power supply unit, which supplies DC power having a predetermined electromotive force; at least one thermal sensor, which senses heat of a corresponding burner and generates a thermoelectromotive force; an input button unit, which receives an operating time control signal for each burner from a user; at least one magnetic opening/closing unit, which maintains a gas supply passage to a corresponding burner when a electromagnetic force is maintained and closes the gas supply passage when the electromagnetic force is lost; a digit display unit, which displays an operating time for each burner in

digits; and a control circuit unit, which controls a electromagnetic force to be supplied to each magnetic opening/closing unit when a thermoelectromotive force of a thermal sensor corresponding to the magnetic opening/closing unit exceeds a predetermined threshold value, controls the electromagnetic force supplied to the magnetic opening/closing unit to be intercepted when an operating time lapses or when the thermoelectromotive force of the thermal sensor does not exceed a predetermined threshold value, and controls and manages an operating time of each burner, which is generated by adjusting a predetermined reference operating time according to the operating time control signal, as time flows. When the operating time control signal for a burner is not received from the input button unit, the control circuit unit controls a electromagnetic force, which is supplied to a magnetic opening/closing unit corresponding to the burner, to be intercepted after the predetermined reference operating time lapses.

The control circuit unit may include a thermoelectromotive amplifier, which amplifies a thermoelectromotive force received from each thermal sensor and turns on a thermal detection signal when the amplified thermoelectromotive force exceeds a predetermined threshold value; a clock oscillator, which generates a clock signal; a microcomputer, which turns on a burner control signal in order to control a electromagnetic force to be supplied to a magnetic opening/closing unit corresponding to the thermal sensor when the thermal detection signal is turned on, gradually decreases the reference operating time or the operating time of each burner according to time information managed by the clock signal of the clock oscillator, and turns off the burner control signal in order to control the electromagnetic force, supplied to the magnetic opening/closing unit, to be intercepted when the reference operating time or the operating time reaches 0 or when the thermal detection signal is turned off; and a digit formation signal generator, which receives reference operating time data or operating time data of

each burner from the microcomputer, generates a digit formation signal corresponding to the received data, and transmits the digit formation signal to the digit display unit.

Brief Description of the Drawings

FIG. 1 illustrates the structure of an overheat prevention apparatus of a gas range, according to a first embodiment of the present invention.

FIG. 2 is a cross-section of a magnetic opening/closing unit included in the overheat prevention apparatus according to the first embodiment of the present invention.

FIG. 3A illustrates the appearance of a gas range including the overheat prevention apparatus according to the first embodiment of the present invention.

FIG. 3B illustrates an "OFF" status of a timer switch included in the overheat prevention apparatus according to the first embodiment of the present invention.

FIG. 3C illustrates a status in which time is set in the timer switch included in the overheat prevention apparatus according to the first embodiment of the present invention.

FIG. 3D is an exploded view of the timer switch included in the overheat prevention apparatus according to the first embodiment of the present invention.

FIG. 4A illustrates the structure of an overheat prevention apparatus of a gas range including a plurality of burners.

FIG. 4B is an exploded view of a timer switch included in an overheat prevention apparatus according to a second embodiment of the present invention.

FIG. 5 illustrates the appearance of a gas range including an electronic overheat prevention apparatus according to the present invention.

FIG. 6 is a block diagram of an electronic overheat prevention apparatus according to the present invention.

FIGS. 7A through 7E are circuit diagrams showing examples of a control circuit unit and other elements of an electronic overheat prevention apparatus according to the present invention.

FIG. 8 is a flowchart of the operation of a microcomputer of an electronic overheat prevention apparatus according to the present invention.

Best mode for carrying out the Invention

Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings.

Referring to FIG. 1, in order to prevent overheating from occurring due to unintended long-time use of a gas range, an overheat prevention apparatus 1 according to a first embodiment of the present invention includes a thermocouple 10, a magnetic opening/closing unit 20, and a timer switch 40.

The thermocouple 10 is installed at a burner (not shown) of a gas range and generates a thermoelectromotive force due to burner fire. The thermocouple 10 is based on the Seebeck effect, where current flows through a closed circuit consisting of two dissimilar conductive metals when they are electrically joined at the two ends and the two ends are at different temperatures. Where one junction (a reference junction) is maintained at a predetermined temperature and the other junction (a measuring junction) is positioned near burner fire, a thermoelectromotive force is obtained due to a temperature difference between the two dissimilar conductive metals.

The magnetic opening/closing unit 20 generates a magnetic force due to the thermoelectromotive force of the thermocouple 10 so as to selectively open or close a gas supply passage connected to the burner of the gas range.

Referring to FIG. 2, in the magnetic opening/closing unit 20, a space 24 is formed within a cylindrical housing 27. An electromagnet 25 and a moving rod 21, which can move back and forth in a horizontal direction, are disposed in the space 24. A metal piece 22 and a finishing element 23 are formed at one end of the moving rod 21. The metal piece 22 is formed to come into close contact with the electromagnet 25, which is magnetized by the thermoelectromotive force of the thermocouple 10. The finishing element 23 is fixed to a rear side of the metal piece 22 so as to selectively open or close a passage to a gas outlet 28 formed in the housing 27. It is preferable that the finishing element 23 is made of a rubber material so as to increase tightness when selectively intercepting the supply of gas.

A first spring 26 is installed around the outer circumference of the moving rod 21 of the magnetic opening/closing unit 20 so as to buffer and return the moving rod 21, which is selectively moved back or forth in the horizontal direction. In other words, the first spring 26 is positioned between the electromagnet 25 and the metal piece 22 and serves to return and buffer the finishing element 23, which is moved back and forth by a magnetic force generated by the electromagnet 25.

The housing 27 of the magnetic opening/closing unit 20 includes a gas inlet 29 and the gas outlet 28, which are connected to the space 24 within the housing 27, and a control hole 30 connected to the gas outlet 28. A push pin 31 is installed in the control hole 30 so as to push an end of the moving rode 21, thereby forming a passage through which gas flows between the space 24 and the gas outlet 28. A keeper plate 32 is installed at a rear side of the push pin 31. A second spring 37 is installed around the outer circumference of the push pin 31 between the housing 27 and the keeper plate 32.

The push pin 31 moves toward the moving rod 21 when a gas control knob 34 is rotated, so as to form a passage for gas flow between the space 24 and the gas outlet 28. The second spring 37, which is set

on the keeper plate 32 at the rear side of the push pin 31, returns the push pin 31 when a user takes off his/her hand from the gas control knob 34 after igniting the burner by rotating the gas control knob 34.

A pressure pin 33 is installed at a portion of a body (not shown) of the gas range or the housing 27 of the magnetic opening/closing unit 20 so as to move the push pin 31 toward the moving rod 21. The pressure pin 33 includes a pressure element 33a at one side, which is formed to be perpendicular to a rear side of the keeper plate 32 installed at the push pin 31, and a rotating element 33b at another side.

A protruding piece 35 is formed at a rear center of the gas control knob 34, and a pressure piece 36 is formed at an outer portion of the gas control knob 34. The protruding piece 35 is formed at a little higher position than the pressure piece 36 with respect to the gas control knob 34 such that when the gas control knob 34 is rotated, the protruding piece 35 rotates the pressure pin 33 so as to move the push pin 31 and the moving rod 21 to allow gas to be supplied to the burner, and then the pressure piece 36 presses a piezoelectric element (not shown) near the gas control knob 34 so as to ignite the burner.

The magnetic opening/closing unit 20 shown in FIG. 2 is only an embodiment of the present invention, and the scope of the present invention is not restricted to this embodiment. Accordingly, it will be easily understood by those skilled in the art of the present invention that any type of magnetic opening/closing unit, which has a function of generating a magnetic force due to the thermoelectromotive force of the thermocouple 10 so as to selectively open or close a passage for supplying gas to the burner, can be included in the scope of the present invention.

The timer switch 40 is installed between one output terminal of the thermocouple 10 and one input terminal of the magnetic opening/closing unit 20. The timer switch 40 electrically disconnects circuits the two

terminals in an "OFF" status or an end-of-set status, but it electrically connects them while a time setup is maintained.

Referring to FIGS. 3A through 3D, the timer switch 40 includes a switching unit 42, a time set knob 44, a spring 46, a pendulum, a toothed wheel unit 50, and a switching operation unit 52.

In an embodiment shown in FIG. 3A, the time set knob 44 is prominently installed at an outer front side of a gas range so that a user can hold and rotate it. The time set knob 44 is maintained at the "OFF" status in a normal mode. When particular time is set by a user rotating the time set knob 44 to a position corresponding to the particular time, the time set knob 44 returns to the "OFF" or end-of-set status after the particular time lapses.

FIG. 3B illustrates a timer switch in an "OFF" status, FIG. 3C illustrates the timer switch, in which time is set, and FIG. 3D is an exploded view of the timer switch.

One terminal 42a of the switching unit 42 is connected to an output terminal of a thermocouple, and the other terminal 42b is connected to an input terminal of a magnetic opening/closing unit. A switching node 42c is installed at the one terminal 42a so as to electrically connect the one terminal 42a to the other terminal 42b. When an elastic force is applied to the switching node 42c, the one terminal 42a of the switching unit 42 is electrically connected to the other terminal 42b. When the elastic force is removed from the switching node 42c, the one terminal 42a of the switching unit 42 electrically disconnects circuits with the other terminal 42b.

The spring 46 receives kinetic energy created by a user through the time set knob 44 and stores it in the form of elastic energy. The elastic energy of the spring 46 is converted into kinetic energy in the toothed wheel unit 50. The converted kinetic energy moves teeth of a plurality of toothed wheels included in the toothed wheel unit 50 one at time in synchronization with a swinging period of the pendulum 48. A

final toothed wheel included in the toothed wheel unit 50 is fixed to a shaft 44a so as to return the time set knob 44 to the "OFF" or end-of-set status, where the final toothed wheel is coaxial with the time set knob 44.

The switching operation unit 52 includes a rotary body 53 and a switching lever 54. The rotary body 53 of the switching operation unit 52 is installed at the shaft 44a, at which the time set knob 44 is installed. A groove 53a is formed at a portion of the rotary body 53. One end of the switching lever 54 is rotatably fixed to a housing 56 of the timer switch. The switching lever 54 includes a first protrusion 54a, which corresponds to the groove 53a of the rotary body 53, at one portion and a second protrusion 54b, which actuates the switching node 42c, at an opposite portion to the first protrusion 54a.

Accordingly, when the time set knob 44 is in the "OFF" status, as shown in FIG. 3B, the first protrusion 54a of the switching operation unit 52 engages with the groove 53a of the rotary body 53, and the second protrusion 54b does not apply a force to the switching node 42c. As a result, the two terminals 42a and 42b of the switching unit 42 are maintained electrically disconnected.

In the meantime, as shown in FIG.3C, when the time set knob 44 is rotated by a user, the first protrusion 54a of the switching operation unit 52 is out of the groove 53a of the rotary body 53, and therefore, the second protrusion 54b applies a force to the switching node 42c. As a result, the two terminals 42a and 42b of the switching unit 42 is maintained electrically connected until the time set knob 44 returns to the "OFF" or end-of-set status.

When a gas range according to the present invention includes a plurality of burners, as shown in FIG. 4A, a thermocouple 10 and a magnetic opening/closing unit 20 are provided for each burner. As shown in FIG. 4B, a timer switch 60 includes a switching unit 62, a time set knob (not shown), a spring 66, a pendulum 68, a toothed wheel unit 70, and a switching operation unit 72, as elements corresponding to the

timer switch 40. The time set knob, the spring 66, the pendulum 68, the toothed wheel unit 70, and the switching operation unit 72 of the timer switch 60 have the same functions as those of the timer switch 40, and thus detailed descriptions thereof will be omitted.

The switching unit 62 of the timer switch 60 includes a plurality of switches 62a. Each of the switches 62a has one end which is connected to one of the two output terminals of each of the thermocouples 10, and the other end which is connected to one of the two input terminals of a corresponding magnetic opening/closing unit 20. The switching operation unit 72 of the timer switch 60 does not apply a force to any of switching nodes 62c included in all of the switches 62a, respectively, in the "OFF" or end-of-set status. However, the switching operation unit 72 simultaneously applies a force to all of the switching nodes 62c so as to turn on all of the switches 62a while a time setup is maintained. In this situation, the switches 62a are insulated from one another. Accordingly, under a state in which time is not set in the timer switch 60, an electromotive force generated by each thermocouple 10 due to fire of a corresponding ignited burner is not transmitted to a corresponding magnetic opening/closing unit 20. As a result, a user cannot use any of the burners without setting time in the timer switch 60.

The mechanical timer switches 40 and 60 shown in FIGS. 3A through 4B are only embodiments of the present invention, and the scope of the present invention is not restricted to these embodiments. Accordingly, it will be easily understood by those skilled in the art of the present invention that any timer switch, which controls electrical flow between a thermocouple and a magnetic opening/closing unit such that the thermocouple and the magnetic opening/closing unit are electrically disconnected in the "OFF" or end-of-set status and connected while time setup is maintained, is included in the scope of the present invention even if the timer switch operates electronically, not mechanically.

Hereinafter, the operations of a gas range according to the present invention will be described in detail.

The following description concerns a situation in which a user tries to turn on a gas range according to the present invention without setting the timer switch 40.

When a user holds and rotates the gas control knob 34 counterclockwise, the rotating protruding piece 35 rotates the pressure pin 33 so as to move the push pin 31 and the moving rod 21 forward, thereby supplying gas to a burner. Thereafter, due to the elasticity of the pressure pin 33 having a twisted coil spring shape, the pressure piece 36 presses a piezoelectric element (not shown) so as to ignite a burner. Accordingly, the thermocouple 10 generates a thermoelectromotive force due to burner fire. However, the timer switch 40 in a closed circuit including the thermocouple 10 and the magnetic opening/closing unit 20 electrically disconnects circuits, and therefore, the magnetic opening/closing unit 20 does not generate a magnetic force.

Thereafter, when the user releases the gas control knob 34, the push pin 31 is moved backward by an elastic force of the second spring 37, and the moving rod 21 is returned to the original position by an elastic force of the first spring 26. As a result, the finishing element 23 blocks a passage to the gas outlet 28 formed in the housing 27. Accordingly, gas is not supplied to the burner any more, and therefore, fire is extinguished. Consequently, the user cannot normally use the gas range according to the present invention without operating the timer switch 40.

The following description concerns a situation in which a user tries to turn on a gas range according to the present invention after setting desired time using the timer switch 40.

When a user sets desired time by rotating the time set knob 44, the first protrusion 54a of the switching operation unit 52 goes out of the groove 53a of the rotary body 53, and thus the second protrusion 54b

applies a force to the switching node 42c, thereby electrically connecting the two terminals 42a and 42b of the switching unit 42. As a result, a closed circuit including the thermocouple 10 and the magnetic opening/closing unit 20 electrically conducts.

Thereafter, when the user holds and rotates the gas control knob 34 counterclockwise, the rotating protruding piece 35 rotates the pressure pin 33 so as to move the push pin 31 and the moving rod 21 forward, thereby supplying gas to a burner. Thereafter, due to the elasticity of the pressure pin 33 having a twisted coil spring shape, the pressure piece 36 presses a piezoelectric element (not shown) so as to ignite a burner. Accordingly, the thermocouple 10 generates a thermoelectromotive force due to burner fire, and the electromagnet 25 of the magnetic opening/closing unit 20 generates a magnetic force due to the thermoelectromotive force transmitted from the thermocouple 10 so as to attract the metal piece 22 and the finishing element 23 and maintains this attraction status.

Accordingly, even though the user release the gas control knob 34, the finishing element 23 does not block the passage to the gas outlet 28 formed in the housing 27 so as to maintain a passage for gas supply open although the push pin 31 moved forward is returned to the original position by an elastic force of the second spring 37. As a result, fire in the burner is maintained, and the user can normally use the gas range.

Thereafter, elastic energy of the spring 46 is converted into kinetic energy of the toothed wheel unit 50. The kinetic energy moves a plurality of tooth of each of the plurality of toothed wheel included in the toothed wheel unit 50 one at time in synchronization with the swinging period of the pendulum 48.

After the time set by the user lapses, the final toothed wheel included in the toothed wheel unit 50 returns the time set knob 44 to the "OFF" or end-of-set status. Accordingly, the first protrusion 54a of the switching operation unit 52 engages with the groove 53a of the rotary

body 53, and the second protrusion 54b does not apply a force to the switching node 42c. As a result, the switching node 42c is returned to the original position by an elastic force, and therefore, the two terminals 42a and 42b of the switching unit 42 are electrically disconnected. Thus, a thermoelectromotive force generated by the thermocouple 10 is not transmitted to the magnetic opening/closing unit 20, and a magnetic force of the electromagnet 25 disappears. As a result, the moving rod 21 is returned to the original position by an elastic force of the first spring 26, and therefore, the finishing element 23 blocks a passage to the gas outlet 28 formed in the housing 27. Accordingly, gas is not supplied to the burner, thereby extinguishing fire of the burner.

FIG. 5 illustrates the appearance of a gas range 130 including an electronic overheat prevention apparatus according to the present invention. FIG. 6 is a block diagram of an electronic overheat prevention apparatus 150 according to the present invention.

Referring to FIG. 5, the gas range 130 includes three burners 132. Three gas control knobs 134 corresponding to the three burners 132, a light emitting device (LED) display 136 displaying four digits, three buttons (i.e., a selection button, an up button, and a down button) 138, and three LED lamps 140 corresponding to the three burners 132 are installed on a front side of a housing of the gas range 130. Although not shown in FIG. 5, the gas range 130 includes a gas supply unit, which supplies gas from a butane gas container, a liquefied petroleum gas (LPG) container, or a liquefied natural gas (LNG) hose to each burner 132; and an electronic overheat prevention apparatus, which electronically opens or closes a gas supply passage from the gas supply unit to each burner 132.

In the electronic overheat prevention apparatus, a reference operating time of, for example, 30 through 120 minutes is set in advance. Accordingly, the electronic overheat prevention apparatus closes the gas supply passage so as to turn off the burners 132 when the reference

operating time lapses after ignition of the burners 132 is sensed. In other words, even when a user forgets turning on the gas range 130 and goes out or falls asleep, the burners 132 are absolutely extinguished by the electronic overheat prevention apparatus after the reference operating time lapses.

In the meantime, a user can reset an operating time (i.e., a duration until the gas supply passage is closed) of each burner 132 by selecting a burner 132 to be displayed on the LED display 136 using the selection button and changing the reference operating time using the up button and the down button. Here, a number designating the selected burner 132 and the operating time of the selected burner 132 are displayed on the LED display 136.

In addition, the electronic overheat prevention apparatus maintains a gas supply passage open when temperature of each burner 132 exceeds a predetermined threshold value and closes a gas supply passage when temperature of each burner 132 does not exceed the predetermined threshold value. The electronic overheat prevention apparatus turns on an LED lamp 140 corresponding to a burner 132 to which a gas supply passage is open. Accordingly, after a user ignites a burner 132 by pressing and rotating a corresponding gas control knob 134, the user does not need to maintain the pressing until a thermocouple generates a sufficient thermoelectromotive force to allow a magnetic opening/closing unit to maintain a gas supply passage open and does not need to visually check fire of the burner 132.

Referring to FIG. 6, the electronic overheat prevention apparatus of a gas range according to the present invention includes a power supply unit 152, at least one thermal sensor 154, an input button unit 156, a gas sensor 158, at least one magnetic opening/closing unit 162, at least one operation indicator lamp 164, a digit display unit 166, a speaker 168, and a control circuit unit 160. It is preferable that as many thermal

sensors 154, magnetic opening/closing units 162, and operation indicator lamps 164 as the number of burners 132 are provided in the gas range.

The power supply unit 152 supplies direct current (DC) power of a predetermined electromotive force (for example, 5 V) necessary for operating each member of the electronic overheat prevention apparatus 150. The power supply unit 152 can be implemented by a method using a battery, a method using attenuated and rectified alternating current (AC) power, or a method using attenuated and rectified AC power in a normal state and using a charged battery during a power failure. FIG. 7A is a circuit diagram showing an example of the power supply unit 152.

The thermal sensor 154 senses heat generated by fire of each burner 132 and generates a thermoelectromotive force. The thermal sensor 154 can be used as a thermocouple. A thermocouple is installed near each burner 132 and generates a thermoelectromotive force due to fire of the burner 132. A thermocouple is based on the Seebeck effect, where current flows through a closed circuit consisting of two dissimilar conductive metals when they are electrically joined at the two ends and the two ends are at different temperatures. Where one junction (a reference junction) is maintained at a predetermined temperature and the other junction (a measuring junction) is positioned near burner fire, a thermoelectromotive force is obtained due to a temperature difference between the two dissimilar conductive metals.

The input button unit 156 can be composed of the three buttons 138, i.e., the selection button, the up button, and the down button, as shown in FIG. 5, so as to receive an operating time control signal for each burner 132 from a user. When a user selects a burner 132 using the selection button, a number designating the selected burner 132 and an operating time are displayed on the digit display unit 166. Thereafter, when the user presses the selection button again, another burner 132 ignited next is selected. The order in which the burners 132 are selected is predetermined. In the meantime, when the electronic

overheat prevention apparatus 150 has a current time display function, a current time, an operating time of a first burner, an operating time of a second burner, and an operating time of a third burner are sequentially displayed on the digit display unit 166 in response to the pressing of the selection button. The user can increase or decrease the current time or the operating time, which is displayed on the digit display unit 166, by pressing the up button or the down button.

The gas sensor 158 senses ambient gas and generates an electromotive force. Those skilled in the art of the present invention will be able to easily select an appropriate gas sensor for the present invention from various types of commercialized gas sensors.

The magnetic opening/closing unit 162 maintains a gas supply passage to a burner 132 when a electromagnetic force is maintained and closes the gas supply passage when the electromagnetic force is lost. The structure and operation of the magnetic opening/closing unit 162 are similar to or the same as those of the magnetic opening/closing units 20 shown in FIG. 2, and thus detailed descriptions thereof will be omitted.

The operation indicator lamp 164 indicates whether each burner 132 is ignited and can be implemented by the LED lamp 140, as shown in FIG. 5.

The digit display unit 166 displays an operating time for each burner 132 in digits and can be implemented by the LED display 136 displaying four digits, as shown in FIG. 5.

The speaker 168 generates an alarm sound under the control of the control circuit unit 160.

The control circuit unit 160 controls the electronic overheat prevention apparatus 150 to supply a electromagnetic force to the magnetic opening/closing unit 162 when a thermoelectromotive force of the thermal sensor 154 exceeds a predetermined threshold value and intercepts the electromagnetic force supplied to the magnetic opening/closing unit 162 when the thermoelectromotive force of the

thermal sensor 154 does not exceed a predetermined threshold value. Here, the control circuit unit 160 controls the electronic overheat prevention apparatus 150 to supply the electromagnetic force to the magnetic opening/closing unit 162 and simultaneously supply electric power to the operation indicator lamp 164 so that the user can be informed whether there is fire in a burner 132.

In addition, the control circuit unit 160 controls the electronic overheat prevention apparatus 150 to intercept the electromagnetic force supplied to the magnetic opening/closing unit 162 corresponding to the thermal sensor 154 when a reference operating time lapses after the thermoelectromotive force of the thermal sensor 154 exceeds the predetermined threshold value. The control circuit unit 160 changes the reference operating time according to an operating time control signal input through the input button unit 156 and stores and manages an operating time for each burner 132. The operating time for each burner 132 decreases over time. When the operating time reaches a value 0, the control circuit unit 160 controls the electronic overheat prevention apparatus 150 to intercept the electromagnetic force supplied to the magnetic opening/closing unit 162.

In the meantime, the control circuit unit 160 the speaker 168 to generate an alarm sound when the electromotive force of the thermal sensor 154 exceeds a predetermined value.

The control circuit unit 160 includes a thermoelectromotive amplifier 170, a clock oscillator 172, a microcomputer 174, and a digit formation signal generator 176.

FIGS. 7A through 7E are circuit diagrams showing examples of the control circuit unit 160 and other related elements. The thermoelectromotive amplifier 170 shown in FIG. 7B amplifies a thermoelectromotive force received from the thermal sensor 154, turns on a thermal detection signal when the amplified thermoelectromotive

force exceeds a predetermined threshold value, and transmits the thermal detection signal to the microcomputer 174.

Referring to FIG. 7C, the microcomputer 174 receives a gas detection signal from the gas sensor 158, a thermal detection signal from the thermoelectromotive amplifier 170, an operating time control signal from the input button unit 156, and a clock signal generated by the clock oscillator 172. An internal register (not shown) of the microcomputer 174 manages an operating time of each burner such that the reference operating time is set when the thermal detection signal is turned on, and thereafter can be changed in accordance with the elapse of time managed by a clock signal or changed by the operating time control signal. When the thermal detection signal is turned on, the microcomputer 174 turns on a burner control signal in order to control a electromagnetic force to be supplied to the magnetic opening/closing unit 162 corresponding to the thermal sensor. When the operating time of each burner decreases to 0 over time managed by a clock signal or when the thermal detection signal is turned off, the microcomputer 174 turns off the burner control signal in order to control the electromagnetic force, supplied to the magnetic opening/closing unit 162 corresponding to the burner, to be intercepted and resets the operating time of the burner to 0. As shown in FIG. 7C, it is preferable that the burner control signal controls electric power for the operation indicator lamp 164 corresponding to each burner as well as the electromagnetic force for the magnetic opening/closing unit 162 corresponding to the burner. FIG. 7D illustrates an example of the magnetic opening/closing unit 162 controlled by the burner control signal.

The microcomputer 174 transmits one data, which is selected from a current time, an operating time of a first burner, an operating time of a second burner, an operating time of a third burner, and an operating time of a fourth burner according to a user's operation of the selection button, to the digit formation signal generator 176. Then, the digit formation

signal generator 176 generates a digit formation signal for forming digits corresponding to the received data so as to control the digit display unit 166 to display the digits. FIG. 7E illustrates an example of the digit display unit 166 controlled by the digit formation signal.

In addition, the microcomputer 174 generates an alarm signal so as to control the speaker 168 to output an alarm sound, when it is necessary to inform a user of the result of an important operation, such as turning off the burner control signal in order to intercept the electromagnetic force supplied to the magnetic opening/closing unit 162.

Hereinafter, the operation of the microcomputer 174 will be described with reference to FIG. 8.

When electric power is supplied to the microcomputer 174, it is determined whether gas is detected in an ambient air of a gas range based on a gas detection signal from the gas sensor 158 in step S100. When the gas detection signal is in an ON state, the microcomputer 174 controls the speaker 168 to output an alarm sound for a predetermined period of time and terminates the operation in step S220.

Thereafter, the microcomputer 174 determines whether each burner 132 is ignited based on a thermal detection signal from the thermoelectromotive amplifier 170 in step S110. When the thermal detection signal is in an ON state, the burner 132 is determined as being ignited. However, when the thermal detection signal is in an OFF state, the burner 132 is determined as being extinguished. Under a state where the thermal detection signal is maintained in the ON state, if an operating time of the burner 132 reaches 0, that is, if a predetermined operating time ends, in step S120, the microcomputer 174 controls the speaker 168 to output an alarm sound indicating that fire of the burner 132 is extinguished, in step S130. When the thermal detection signal for the burner 132 is converted from ON to OFF (that is, when the fire of the burner 132 is extinguished by accident or intention), the microcomputer 174 resets the operating time of the burner 132 to 0 in

step S140. In addition, when the thermal detection signal for the burner 132 is in the OFF state, or when the operating time of the burner 132 reaches 0, the microcomputer 174 turns off a burner control signal to control the magnetic opening/closing unit 162 to intercept gas supplied to the burner 132 and controls the operation indicator lamp 164 corresponding to the burner 132 to be turned off in step S140.

When the thermal detection signal is converted from OFF to ON, a reference operating time is allocated as the operating time of the burner 132. In addition, when the thermal detection signal is in the ON state and the operating time of the burner 132 is set to another value than 0, the burner control signal is maintained in the ON state in step S150. When the burner control signal is in the ON state, the magnetic opening/closing unit 162 opens a gas supply passage to the burner 132 so as to maintain the ignited state, and the operation indicator lamp 164 is turned on so that a user can recognize the ignited state of the burner 132.

The user can select a current time or the operating time of one among ignited burners using the selection button in step S160. Here, a selection mode is recorded in the register of the microcomputer 174. When the selection mode is determined as a burner mode in step S170, the microcomputer 174 controls the digit display unit 166 to display the operating time of the ignited burner selected using the selection button and allows the operating time of the burner to be reset using the up button or the down button of the input button unit 156 in steps S180 and S190. When the selection mode is determined as a time mode in step S170, the microcomputer 174 controls the digit display unit 166 to display the current time and allows the current time to be reset using the up button or the down button of the input button unit 156 in steps S200 and S210.

Steps S100 through S210 are repeated while electric power is supplied to the microcomputer 174.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes may be made therein without departing from the scope of the invention. Therefore, the above-described embodiments will be considered not in restrictive senses but in descriptive senses only. The scope of the invention will be defined by the appended claims, and it will be construed that all differences made within the scope defined by the claims are included in the present invention.

Industrial Applicability

According to an overheat prevention apparatus of the present invention, a user needs to set an operating time by operating a timer switch before igniting a gas range in order to use the gas range, and fire of a burner of the gas range is absolutely extinguished after the operating time lapses.

Accordingly, if the user forgets to turn off the gas range, fire of the burner is automatically extinguished after the operating time set by the user in advance lapses, thereby preventing accidents from occurring.

In addition, according to an electronic overheat prevention apparatus of the present invention, when a predetermined time lapses after a burner is ignited, gas supply is absolutely intercepted regardless of user's recognition or operation, thereby preventing accidents from occurring due to user's carelessness.

Moreover, according to an electronic overheat prevention apparatus of the present invention, when fire of a burner is sensed, a sufficient electromotive force is immediately supplied to a magnetic opening/closing unit so that a gas supply passage is maintained open. Accordingly, after igniting the burner using a gas control knob, a user does not need to continuously press the gas control knob in order to make a thermocouple generate a sufficient thermoelectromotive force to

allow the magnetic opening/closing unit to maintain the gas supply passage open. In addition, the present invention provides means for easily checking the gas fire so that the user does not need to directly check the fire with his/her eyes.